60% Hydrologic Study Review

Defect Analysis

Method:

① *Calculate volume of water draining in hole on daily basis*

volume of water = daily precipitation x drainage area

② *Convert to infiltration over cover surface*

Infiltration from defect = $\dfrac{\text{volume of water}}{\text{area of cover}}$

Results

	Base Case	Extreme Case
Average Annual Run-Off Into Hole	196 gallons	281 gallons
Average Annual Infiltration Added to Breakthrough From Water Storage Layer	0.01 mm	0.02 mm

200 cm

Drainage Area

20 cm

Run-on

Run-on   Run-on

Water Storage Layer

Bio Intrusion Layer
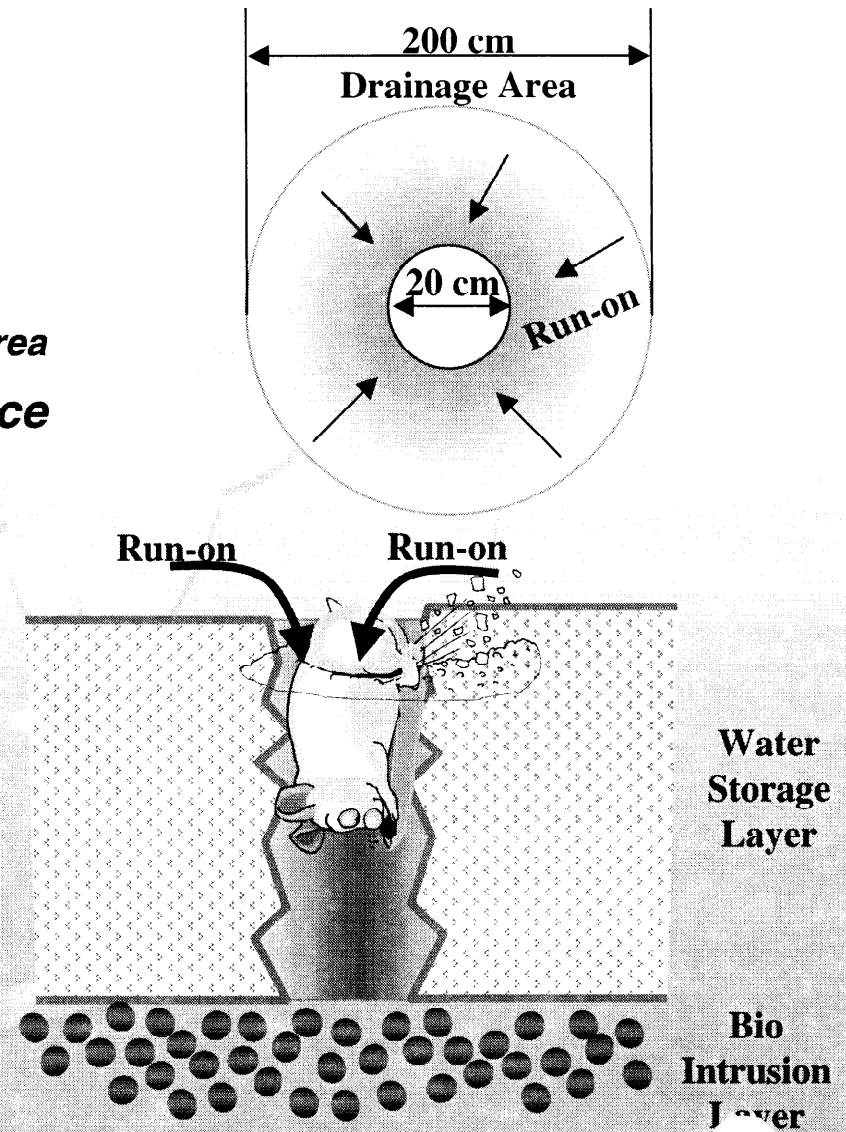
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Lateral Drainage

Method:

① **Use saturated steady-state flow equation to confirm that lateral drainage has capacity to remove water that breaks through water storage layer**
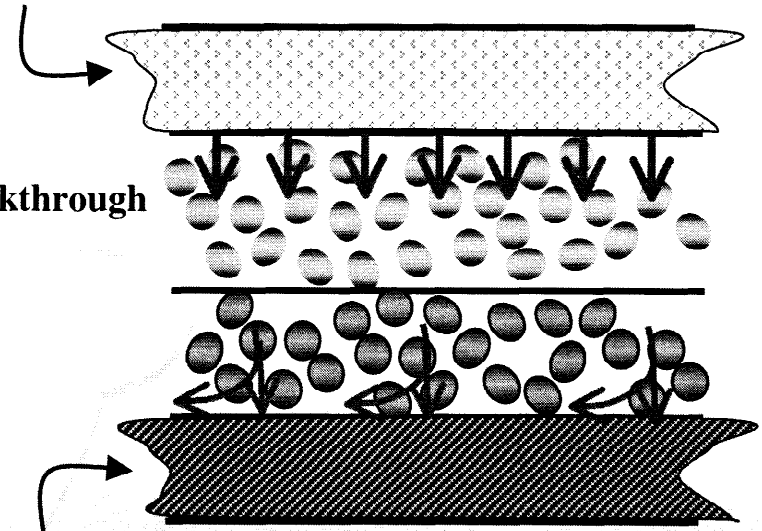
Water Storage Layer

Breakthrough

Compacted Clay Liner

Results

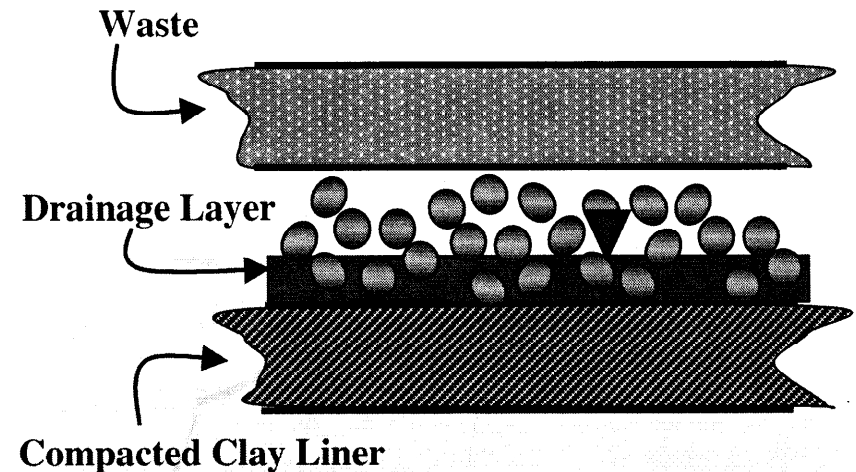|	Base Case	Extreme Case
Volume of Water That Could Drain (no percolation from clay)	29,600 gallons/yr	36,000 gallons/yr
Volume of Water in Terms of Water Thickness Over Cover Area	894 mm/yr	1,094 mm/yr

Conclusion: Lateral drainage exceeds infiltration from upper cover so minimal head above clay surface

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Percolation from Compacted Clay Liner

Study: *Evaluation of Landfill-Liner Designs*
(Peyton R.L. & Schroeder P.R., 1990)

◆ *Single compacted clay liner underlying leachate collection system*

◆ *Cover slope 3%*

◆ *Drainage length 23 m*

◆ *Inflow to lateral drainage*

➡ *203 mm/yr*

➡ *1,278 mm/yr*

◆ *Heads over clay range from 19 to 153 cm*

Waste

Drainage Layer

Compacted Clay Liner

Results from ICDF

	Base Case	Extreme Case
Inflow	0.41	0.48
Percolation	0.08 mm	0.09 mm

Conclusion:

Clay with $k_s = 1 \times 10^{-7}$ cm/sec

80% of inflow is lateral drainage and 20% percolation

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Summary of Results

Point	Description	Base Case Value	Direction	Extreme Case Value	Direction
A	Average Annual Precipitation (mm/year)	237	Downward	338	Downward
A	Adjusted Average Annual Precipitation[1] (mm/year)	236	Downward	335	Downward
B	Evapotransportion (mm/year)	235	Upward	334	Upward
C	Surface Runoff (mm/year)	1.33	Lateral	3.33	Lateral
D	Bio-intrusion[2] (mm/year)	0.01	Downward	0.02	Downward
D	Water Storage Layer Breakthrough (mm/year)	0.40	Downward	0.46	Downward
E	Lateral Drainage Removal Capacity[3] (m³/year)	112	Lateral	136	Lateral
F	Percolation at Base of Cover[4] (mm/year)	0.1	Downward	0.1	Downward

Notes:

1. Precipitation adjusted based on surface runoff.

2. Bio-intrusion includes a hole in the water storage layer caused by an borrowing animal.

3. Lateral drainage removal capacity is based on the hydraulic head determined from the upper landfill cover section infiltration rate. Greater removal capacities are possible for a larger hydraulic head.

4. Percolation at the base of cover is based on 20 percent of the water storage layer breakthrough.

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Thickness Sensitivity Analysis

Average Annual Infiltration through Silt Loam Layer of Varrying Thickness